8 pts

09/831337
JC08 Rec'd PCT/PTO 07 MAY 2001

TENSION FORCE ADJUSTABLE PRESTRESSED GIRDER

BACKGROUND OF THE INVENTION

insert a1

1. Field of the Invention

The present invention relates to a girder, and more particularly, to a tension force adjustable prestressed girder which can compensate for sagging or cracks of a girder generated due to a long-term load and is capable of adjusting a tension force by increasing a load-resisting force of a bridge or building, if necessary, after the construction thereof.

2. Description of the Related Art

In general, when girders installed on a column of a concrete bridge become obsolete as time passes or heavy vehicles exceeding the originally designed weight allowance of a bridge pass over the bridge for a prolonged period, the beam of the bridge may become damaged and an excessive sagging may occur at the girders. Concurrently, bending/tensile cracks are generated and, when such damage continues, the bridge may ultimately collapse. Thus, appropriate repair and reinforcement of the bridge is required.

Meanwhile, a prestressed concrete (PSC) bridge is repaired and reinforced by means of an external steel wire reinforcement construction method. According to the above reinforcement construction method, an externally installed steel wire is to be fixed appropriately at an end portion of a girder. However, it is difficult to install a wire fixing apparatus at the end portion of a girder and reliability on the load-resisting force of the wire fixing apparatus is not assured. Thus, although other methods have been suggested and applied, no effective apparatuses have been developed yet. That is, when cracks and sagging occur in a PCS bridge, it is very difficult to repair and reinforce the bridge.

Also, as the traffic volume continuously increases and automobile manufacturing technologies develop, the weight of a vehicle increases. With an increase in the weight of a vehicle, the specifications which is a standard of designing a bridge must be modified. Modifications of the specifications necessarily results in an unbalanced load-resisting state, i.e., the load-resisting forces of the existing bridges are not matched. In other words, in a state in which roads allowing

passage of heavy trucks and roads not allowing passage of heavy trucks exist together, the efficiency of transportation network system as a whole is severely lowered. Thus, to make the unbalanced load-resisting forces of these bridges consistent, an economical reinforcement method for upgrading the level of the bridge from 2 to 1 must be urgently found.

As the width of a road increases due to an increase in the number of lanes of a road, the development of a wide span girder for constructing an elevated road or an overpass crossing a wide road has proceeded. Although a preflex beam has been developed and used for the above purposes, conveying the girder is inconvenient due to the length thereof and because the costs are high.

Currently, high strength concrete is used for a girder less than 30 m long that is not a wide span girder. However, as a high tension force is applied to the girder, the amount of creep generated becomes great. As the creep increases, the girder sags further which directly affects the longitudinal alignment of the road. When the longitudinal alignment deteriorates, a coefficient of impact by passing vehicles increases. Thus, in the case of a high strength girder or a wide span girder, when the girder is used for a long time, an appropriate construction method for compensating for sagging of the girder is required.

Also, the height of a girder which is long in span is relatively high such that the girder itself is 2.00 m - 3.00 m high. Such a fact entails an increase in the height of an upper deck of an overpass so that, to secure a longitudinal alignment of the overpass matching the designed vehicle speed, the length of the overpass becomes longer, thus raising the construction costs. In the case of a bridge crossing a river, to lower the height of the girder as low as possible is inevitably needed for improving the usability and the economic value of the girder.

FIG. 1 shows the structure of a general bridge. As shown in the drawing, a plurality of I-type girders 12 are installed on a column 10. An upper deck slab (not shown) is installed on the girders 12 of the bridge.

FIG. 2 is a sectional view showing a girder in which steel wires are arranged according to the conventional technology. As shown in the drawing, a girder 20 consists of a body portion 22, an upper flange 28, and a lower flange 24. A plurality of steel wires 26 are built in the body portion 22 in the lengthwise direction. An

upper deck of a bridge is installed on the upper flange 28 and the bottom surface of the lower flange 24 is supported by the column 10.

After the I-type girder 20 according to the conventional technology is constructed, when the bridge is damaged, that is, sagging or cracks are generated due to the increased traffic volume passing over the bridge, or when the designed passage load must be increased according to the revision of the specifications, reinforcement of the bridge is required. However, there are no economical and reliable reinforcement methods applicable therefor.

SUMMARY OF THE INVENTION

It is an objective of the present invention to provide a prestressed girder of which a tension force can be adjusted by adjusting a tension force of a steel wire provided in a body portion or lower flange of the girder to easily increase a load-resisting force of a bridge or building, when excessive sagging or cracks are generated in a girder due to long-term úse or when there is a need to increase the load-resisting force of the bridge or building without damaging the bridge or building.

Accordingly, to achieve the above objective, there is provided a tension force adjustable prestressed girder for adjusting a load-resisting force which consists of an upper flange supporting an upper deck of a bridge installed thereon, a body portion, and a lower flange, which includes tension steel wires provided in a lengthwise direction of the girder and tensioned to compensate for the load-resisting force, and at least one or more non-tension steel wires provided in the lengthwise direction of the girder, so that the load-resisting force of the bridge can be increased by tensioning the non-tension steel wires.

It is preferred in the present invention that the tension force adjustable prestressed girder further comprises a cut-open portion at a predetermined portion in the lengthwise direction of the girder and a coupling member installed at the cut-open portion for fixing one ends of the steel wires of which the other ends are fixed at an end portion of the girder.

According to another preferred embodiment of the present invention, there is provided a tension force adjustable prestressed girder for adjusting a load-resisting force which consists of an upper flange supporting an upper deck of a bridge

installed thereon, a body portion, and a lower flange, which includes tension steel wires provided in a lengthwise direction of the girder and tensioned to compensate for the load-resisting force, and one or more non-tension steel wires provided in the lengthwise direction of the girder, so that the load-resisting force of the bridge can be increased by tensioning the non-tension steel wires during construction of the girder and/or after the construction thereof.

Although the present invention can be applied to any type of girder regardless of the shape of the section of the girder such as an I-type girder or a bulb T-type girder, the I-type girder is described in the below preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 is a perspective view showing the structure of a general bridge;

FIG. 2 is a sectional view showing the arrangement of steel wires in the girder according to conventional technology;

FIG. 3A is a sectional view showing the arrangement of steel wires in the middle portion of a girder according to the present invention;

FIG. 3B is a sectional view showing the steel wires according to another preferred embodiment of the present invention;

FIG. 4A is a sectional view showing the arrangement of steel wires at the end portion of the girder of FIG. 3A;

FIG. 4B is a sectional view showing the arrangement of steel wires at the end portion of the girder of FIG. 3B;

FIG. 5 is a view showing a cut-open portion located at the middle portion of the girder and the arrangement of the steel wires in the girder;

FIG. 6 is a side view showing an example of a steel wire fixed at the end portion of the girder; and

FIG. 7 is a perspective view showing an example of the steel wires in the cut-open portion.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 3A , a girder 40 includes an upper flange 28, a lower flange 24, and a body portion 22. One or more tension steel wires 26 and non-tension steel wires 27 are built in and across the lower portion of the body portion 22 and the lower flange 24 of the girder 40 in the lengthwise direction of the girder 40.

Preferably, the non-tension steel wires 27 are built in the lower flange 28 horizontally parallel to each other, as shown in FIG. 3A. The upper flange 28 is provided above the body portion 22 in the latitudinal direction in the section of the girder 40 and an upper deck of a bridge is installed on the upper flange 28. The lower flange 24 is provided below the body portion 22 in the latitudinal direction in the section of the girder 40 and the bottom surface thereof is supported by a column (not shown).

FIG. 3B shows a steel wire according to another preferred embodiment of the present invention. As shown in the drawing, a plurality of non-tension steel wires 27a are provided in the lengthwise direction of the girder 40 outside the lower portion of the body portion 22. The non-tension steel wires 27a have the same function as that of the non-tension steel wire 27 provided in the lower flange 24, as shown in FIG. 3A. That is, after a bridge is constructed, sagging of the girder 40 is compensated for by tensioning the non-tension steel wires 27a. Also, the non-tension steel wires 27a can be more easily installed compared to a case of being installed inside the lower flange 24.

FIG. 4A shows the arrangement of the steel wires built in the girder of FIG. 3A. As shown in the drawing, the tension steel wires 26 and the non-tension steel wires 27 concentrated at the lower portion of the girder 40 are distributed throughout the entire sectional portion of the girder 40. That is, the steel wires are evenly distributed symmetrically in up/down and left/right sides of the girder 40 so that the tension force by the tension steel wires 26 and the non-tension steel wires 27 can be evenly distributed throughout the entire portion of the girder 40.

FIG. 4B shows the arrangement of the steel wires at the end portion of the girder shown in FIG. 3B. As shown in the drawing, the tension steel wires 26 or the non-tension steel wires 27 and 27a concentrated at the lower portion of the girder as shown in FIG. 3B are evenly distributed symmetrically in the up/down and left/right

sides so that the tension force by the tension or non-tension steel wires 26, 27 or 27a are evenly distributed throughout the entire portion of the girder 40.

FIG. 5 shows the arrangement of the steel wires in the lengthwise direction in the girder of FIG. 3A and a cut-open portion located in the middle of the girder. The tension steel wires 26 and the non-tension steel wires 27 provided inside the girder 40 are concentrated in the lower portion at the middle portion of the girder 40 and evenly distributed throughout the entire sectional portion of the girder 40 at both end portions of the girder 40. The tension and non-tension steel wires 26 and 27 are fixed at both ends of the girder 40 by a fixing means 32 which is an anchoring device. The fixing member 32 is covered with concrete (not shown) after the girder 40 is constructed.

Here, when the girders are installed having intervals therebetween, or when a portion of the end of the girder is cut away, as shown in the drawing, a space is formed between the adjacent girders. Thus, a tensioning work can be performed in the space when the tension and non-tension steel wires 26 and 27 are to be re-tensioned later. However, in this case, the end portion of the girder 40 must not be covered with concrete. Here, one end of the non-tension steel wires 26 and 27 is exposed at either end portions of the girder 40 to apply a tension force.

Also, in a preferred embodiment, the girder is provided with a cut-open portion 36 for adjusting the tension force of the non-tension steel wires 27 at the middle portion of the girder or at another appropriated position. The cut-open portion 36 is used as a space for accommodating a coupling member of the non-tension steel wires 27. That is, the cut-open portion 36 is used as a working space for adjusting the tension force of the non-tension steel wires 27 later.

When cracks 34 or excessive sagging 35 indicated by a dotted line is generated to the girder 40 according to the present invention, as shown in FIG. 5, one or more non-tension steel wires 27 and 27a installed inside or outside the girder 40 are additionally tensioned for reinforcement. Here, the additional tensioning work for the non-tension steel wires 27 and 27a is performed using a hydraulic jack. Also, the tension forces of the non-tension steel wires 27 and 27a are adjusted during or after slab casting and after construction, the tension force is adjusted while the bridge is in use. That is, in the case of a continuous bridge, re-tensioning can

be performed before slab casting. However, in the present invention, the re-tensioning is performed shortly after the slab casting before slab concrete is hardened to prevent application of a tension force on the slab.

FIG. 6 shows a preferred embodiment of fixing the steel wire at the end portion of the girder. The steel wire 26 is anchored using a support member 50 as an anchoring device. For example, the steel wires 26 is inserted into a hole formed at the center of the support member 50 at one end of the girder 40. A plurality of wedges 52 are inserted between the steel wire 26 and the support member 50. Here, the steel wire 26 is tensioned by a hydraulic jack and the tensioned steel wire 26 is fixed by the wedges 52.

FIG. 7 shows that steel wires are coupled by the coupling member as a preferred embodiment of a steel wire connection in the cut-open portion. As shown in the drawing, the cut-open portion 36 is formed in the middle of the bottom surface of the girder 40 in the lengthwise direction. The steel wires 26 fixed at both ends of the girder 40 are connected to a coupling member 62 such that forces of different directions are applied. Here, the tension steel wire 26 to be connected at the coupling member 62 is connected using the support member 50 and the wedges 52.

Thus, the non-tension steel wires 27 connected to each other by the coupling member 62 is tensioned and fixed by using the wedges 52 so that the tension force by the tension steel wire 26 can be maintained. Also, by applying a tension force to the non-tension steel wires 27 and 27a provided at left and right sides of the girder 40, bending of the girder 40 to the left or right can be compensated for.

According to the arrangement of steel wires and the coupling apparatus the present invention, when a bridge is constructed or at an initial stage of construction, the steel wires 26 and 27 are connected to the coupling member 62 to be capable of moving to a degree, while the steel wires installed outside the girder 40 are not tensioned at all or tensioned by a small tension force so as to increase the tension forces of the steel wire later.

Although a bridge is described as an example in the above preferred embodiment, the tension force adjustable prestressed according to the present invention can be applied to other concrete structure such as a building as another preferred embodiment.

It is noted that the present invention is not limited to the preferred embodiment described above, and it is apparent that variations and modifications by those skilled in the art can be effected within the spirit and scope of the present invention defined in the appended claims.

Sub B3

As described above, according to the present invention, cracks and sagging of a bridge generated due to long-term deterioration, creep or overload can be corrected by additionally tensioning steel wires installed internally or externally at a girder of the bridge. Thus, repair and reinforcement of the bridge is easy so that the load-resisting force of the bridge can be easily increased. Also, by adjusting the tension force step by step, the girder can be economically manufactured or the height of the girder can be decreased.